

First Report of *Cestopagurus* Bouvier (Crustacea: Decapoda: Anomura: Paguridae) from the Pacific Ocean, and the Description of a New Species

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Abstract A new, deep-water species is assigned to the hermit crab genus *Cestopagurus* Bouvier, 1897, previously known from the eastern Atlantic and the western Indian Ocean, including the Red Sea. The assignment is made because of the similarities in the structure and number of the gills and in the sexual tube development in males. The new species, *C. puniceus*, substantially differs from the two congeneric species, *C. timidus* (Roux, 1830) and *C. coutieri* Bouvier, 1897, in the weak development of the rostrum, the markedly elongate antennular peduncles, the unarmed right chela, and the concave mesial face of the carpus of the right cheliped. The new species is the first representative of *Cestopagurus* from the Pacific Ocean.

Key words: Crustacea, Decapoda, Anomura, Paguridae, *Cestopagurus puniceus*, new species, Sagami-nada, Japan, Pacific Ocean.

Introduction

The genus *Cestopagurus* was proposed by Bouvier (1897) for *Cestopagurus coutieri* Bouvier, 1897. Since Bouvier (1897), the following six species had been assigned to the genus (Alcock, 1905; Balss, 1915; Edmondson, 1951; Wass, 1963; Lewinsohn, 1969; Miyake, 1978): *Cestopagurus olfaciens* Alcock, 1905; *Cestopagurus helleri* Balss, 1915; *Cestopagurus setosus* Edmondson, 1951; *Cestopagurus lineatus* Wass, 1963; *Cestopagurus pectinipes* Lewinsohn, 1969; and *Catapagurus misakiensis* Terao, 1914. De Saint Laurent (1968a, 1968b, 1969, 1970a, 1970b) revised *Cestopagurus* and *Catapaguroides* A. Milne Edwards & Bouvier, 1892, and as a result, *Cestopagurus* was restricted to the two species, *C. coutieri* and *C. timidus* (Roux, 1830), of which the latter was previously assigned to *Catapaguroides*. The other four species were transferred to *Catapaguroides* (*C.*

olfaciens, *C. setosus* and *C. pectinipes*) or *Solenopagurus* de Saint Laurent, 1968 (*C. lineatus*) (de Saint Laurent, 1968a, 1968b, 1970b). De Saint Laurent (1968a) suggested that *C. helleri* was transferred to *Acanthopagurus* de Saint Laurent, 1968, but later de Saint Laurent (1969) commented that the taxonomic status of *C. helleri* was uncertain. Miyake (1978) placed *Catapagurus misakiensis* in *Cestopagurus*, although he did not provide detailed comments. He referred six female specimens from Sagami Bay to *Cestopagurus misakiensis*. However, Asakura (2001) showed that all of the Miyake's specimens represented *Catapagurus japonicus* Yokoya, 1933. The genus *Cestopagurus* is characterized by the eleven pairs of distally divided quadriseriate gills, the markedly unequal chelipeds and the possession of a long right sexual tube oriented toward the left across the ventral body surface (McLaughlin, 2003a). *Cestopagurus coutieri* is known from the Red Sea and Madagascar (de

Saint Laurent, 1968; Lewinsohn, 1969); and *C. timidus* is known from the Mediterranean and the eastern Atlantic from Scotland to Canary Islands (Ingle 1993).

During research cruises to the Sagami-nada Sea area of central Japan (RV *Tansei-Maru*, KT97-1 and KT98-14 cruises and TRV *Shin'yo-Maru* cruise in 2002), samplings using dredges were made on hard bottoms or steep slopes despite the risk of loss or damage to the gears. These surveys resulted in the significant location of a rich benthic fauna, and a number of new species of decapod crustaceans was discovered (Komai, 2001; Komai & Kim, 2004; Komai & Takeda, 2004; Komatsu & Takeda, 2004). In this paper, a new species of pagurid hermit crab, *Cestopagurus puniceus*, is described based on material from upper bathyal waters around Izu-Oshima Island, Izu Islands. The new species is assigned to *Cestopagurus* Bouvier, 1897 because of the possession of the eleven pairs of distally quadriserial gills, markedly unequal chelipeds and the development and structure of the right sexual tube in males, although it is easily distinguished from the two congeners by a number of morphological characters. It is the first representative of *Cestopagurus* reported with certainty from the Pacific Ocean.

Material and Methods

Specimens examined in this study are deposited in the Natural History Museum and Institute, Chiba, Japan (CBM) and Showa Memorial Institute, National Science Museum, Tokyo, Japan (NSMT S). The shield length, abbreviated as SL, was measured from the tip of rostrum to the midpoint of posterior margin of the shield. For detailed observation of the surface structure on the integument, the specimens (including removed appendages) were stained with methylene blue. Terminology used in the description, for the most part, follows that of McLaughlin (2003a), with exception of the posterior carapace lineae (McLaughlin, 2003b), gill structure (Lemaitre, 2004), dactylus (dactyli) for dactyl (dactyls), and

numbered thoracic sternites. The drawings were made with the aid of a drawing tube mounted on a Leica MZ8 stereomicroscope.

For comparison, the following material was examined.

Cestopagurus timidus: Lesvos Island, Greece, Mediterranean, intertidal, July 1992, coll. S. De Grave, 1 female (SL 1.9 mm). 1 ovigerous female (SL 1.8 mm), CBM-ZC 6228.

Taxonomic account

Cestopagurus puniceus sp. nov.

[New Japanese name: Izu-usubeni-yadokari]

(Figs. 1–6)

Type material. Holotype. RV *Tansei-Maru*, KT98-14 cruise, stn 2, Sagami-nada Sea, west of Izu-Oshima Island, Izu Islands, 34°44.538'N, 139°19.723'E, 257–264 m, 29 August 1998, dredge, coll. T. Komai, male (SL 2.1 mm), CBM-ZC 8356.

Paratypes. Same data as holotype, 5 males (SL 1.6–2.3 mm), 1 female (SL 1.6 mm), CBM-ZC 8357. RV *Tansei-Maru*, KT97-1 cruise, stn OS-1, west of Izu-Oshima Island, 34°44'N, 139°20'E, 278–300 m, 27 February 1997, dredge, coll. E. Tsuchida, 2 males (SL 1.9, 2.2 mm), 2 ovigerous females (SL 2.0, 2.0 mm), CBM-ZC 8358. TRV *Shin'yo-Maru*, 2002 cruise, stn 35, off Izu-Oshima Island, 34°43.24'N, 139°16.84'E, 171–181 m, 24 October 2002, dredge, 2 males (SL 1.8, 2.0 mm), NSMT-Cr S007.

Description. Eleven pairs of distally quadriserial phyllobranchiae present.

Shield (Fig. 2B) 1.0–1.1 times longer than broad, moderately well calcified; anterior margin between rostrum and lateral projections slightly concave; anterolateral margins sloping; posterior margin truncate; dorsal surface slightly convex, with longitudinal rows of 3 or 4 tufts of short setae laterally. Rostrum broadly triangular, terminally blunt to acute, slightly overreaching lateral projections. Lateral projections weakly produced, broadly triangular, unarmed. Posterior carapace smooth, with only 2 pairs of tufts of short setae laterally, mesial pair on posteromedian plate and

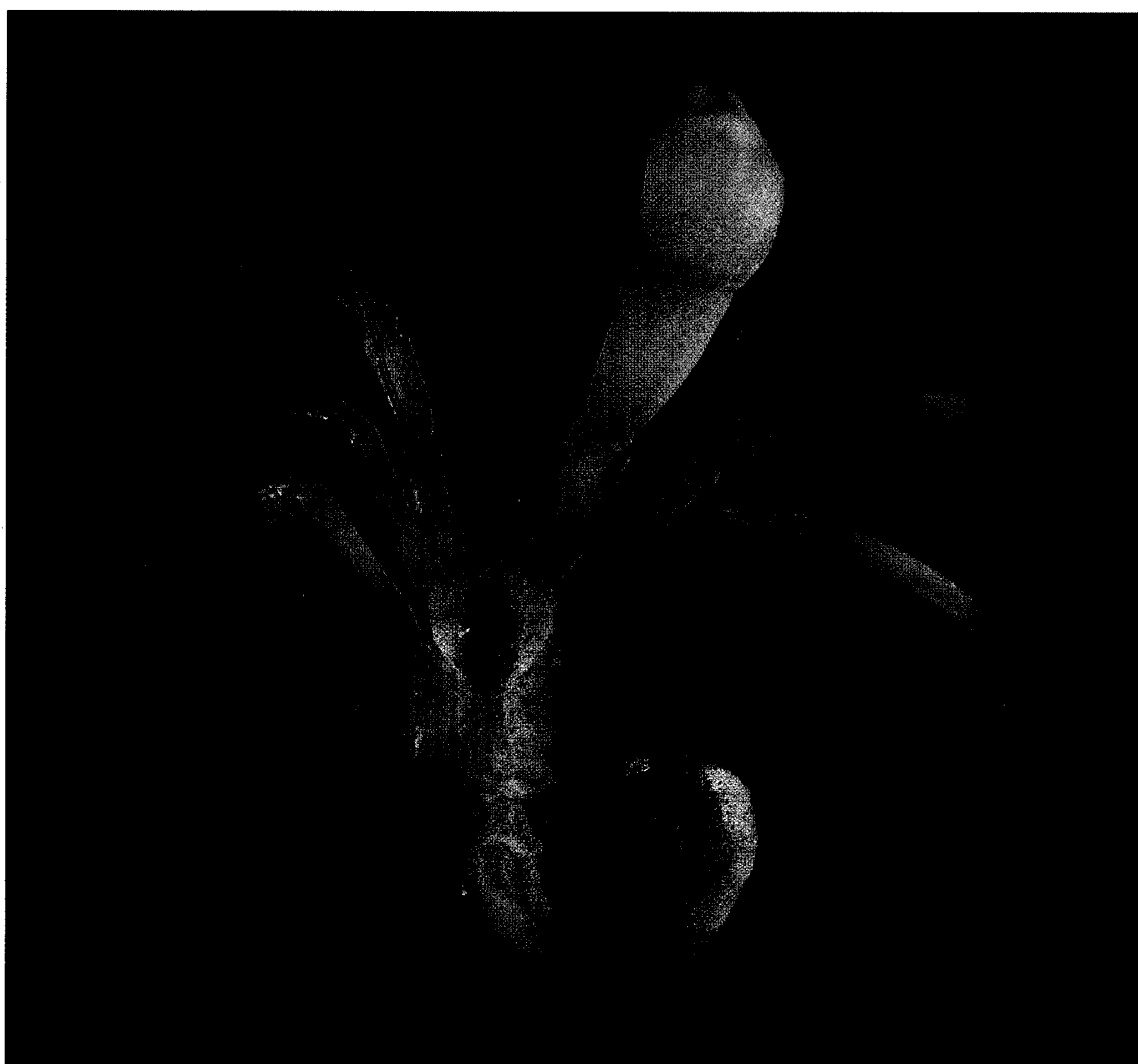


Fig. 1. *Cestopagurus puniceus* sp. nov. Paratype male (SL 1.8 mm). Entire animal, dorsal view.

lateral pair on branchiostegite.

Ocular peduncles (Fig. 2B) moderately short and stout, about 0.6 of shield length, about 2.7 times longer than corneal width; dorsal surface of peduncle with longitudinal row of 3 or 4 tufts of setae (setae increasing in length distally) mesially; corneas not dilated; basal part of peduncle weakly inflated, width greater than corneal width. Ocular acicles subovate or subtriangular, with or without submarginal spine distally, moderately separated basally. Interocular lobe visible in dorsal view, anterior surface slightly concave.

Antennular peduncles (Fig. 2B, D) overreaching distal margin of cornea by entire length of ultimate segments. Ultimate segment 2.0–2.3 of

penultimate segment length, about 4.3 times longer than distal depth, dorsal surface with 3 or 4 tufts of moderately long setae. Basal segment with slender spine on dorsodistal margin of statocyst lobe. Dorsal flagellum slightly longer than ultimate segment, aesthetasc-bearing portion less than half of ultimate segment length. Ventral flagellum about 0.7 length of ultimate segment.

Antennal peduncles (Fig. 2B) overreaching distal margins of corneas by 0.3–0.5 of fifth segments and reaching to level of midlength of ultimate segments of antennular peduncles. Fifth and fourth segments with few short setae. Third segment with small spine at ventromesial distal angle, hardly visible in dorsal view. Second segment with dorsolateral distal angle moderately

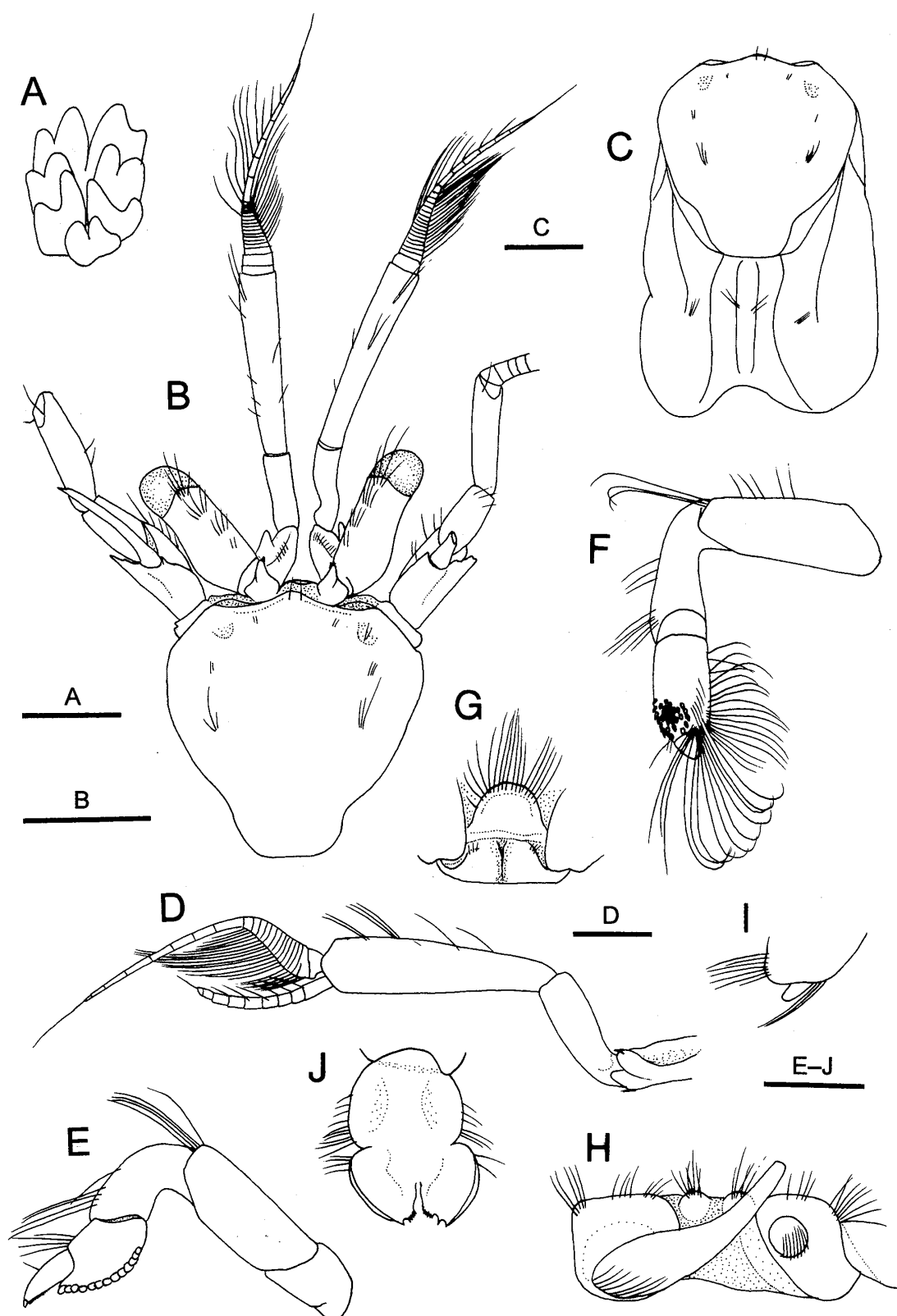


Fig. 2. *Cestopagurus puniceus* sp. nov. Holotype male (SL 2.1 mm; CBM-ZC 8356) from west of Izu-Oshima Island. A, ventral part of posterior arthrobranch above left cheliped; B, shield and cephalic appendages, dorsal view; C, carapace, dorsal view; D, left antennule, lateral view; E, left fourth pereopod, lateral view; F, left fifth pereopod, lateral view; G, sixth thoracic sternite, ventral view; H, coxae of fifth pereopods and eighth thoracic sternite, ventral view; I, ventral part of coxa of right fifth pereopod, lateral view, showing very short sexual tube; J, telson, dorsal view. Scale bars: 0.25 mm for A, 1 mm for B, 0.5 mm for C-J.

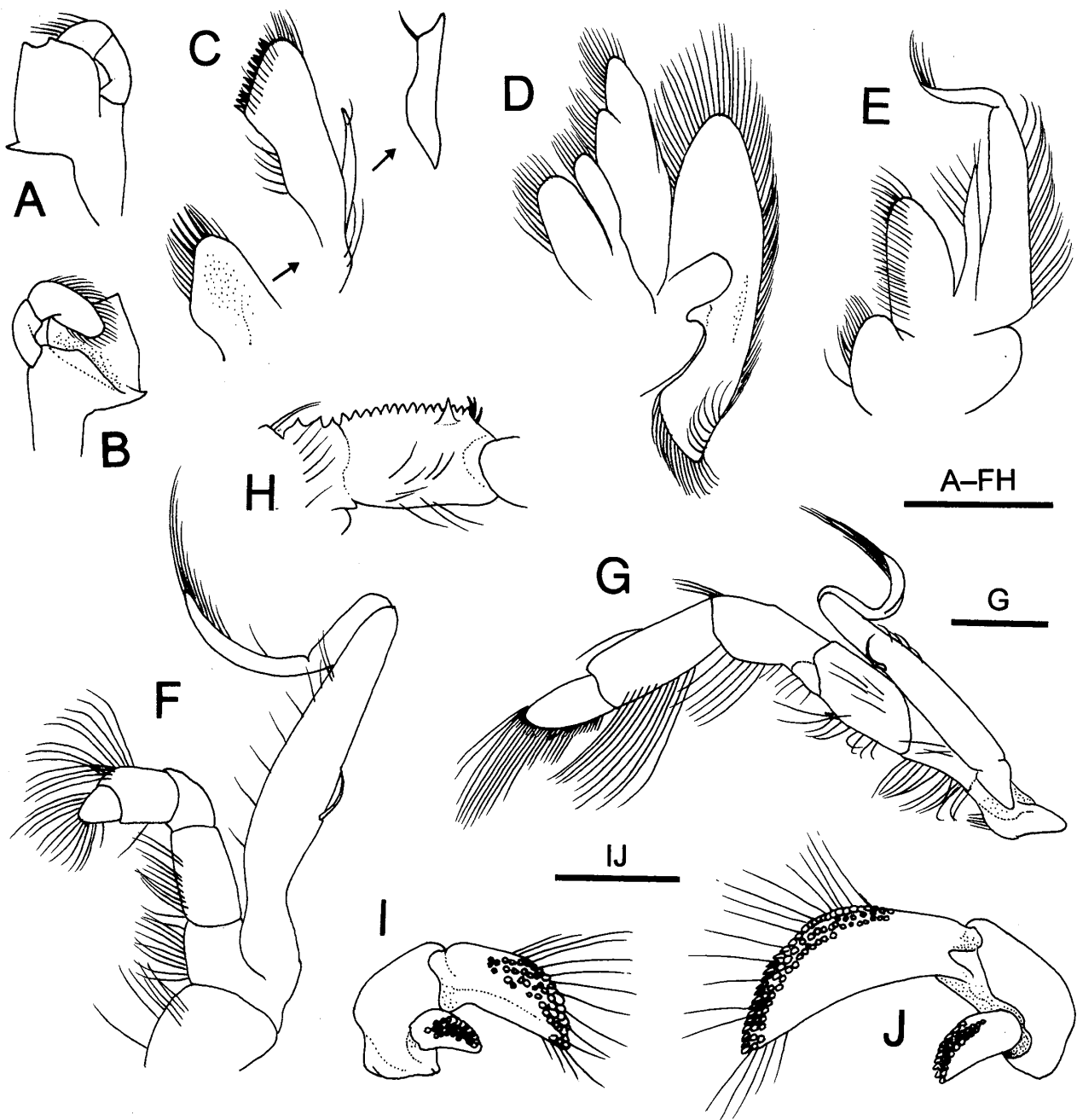


Fig. 3. *Cestopagurus puniceus* sp. nov. Holotype male (SL 2.1 mm; CBM-ZC 8356) from west of Izu-Oshima Island. A, left mandible, ventral view; B, same, dorsal view; C, left maxillule, ventral view; inset, endopod, lateral view; inset, proximal endite, ventral view; D, left maxilla, ventral view; E, left first maxilliped, ventral view; F, left second maxilliped, ventral view; G, left third maxilliped, lateral view; H, same, basis and ischium, ventral view; I, left uropod, lateral view; J, right uropod, lateral view. Scale bars: 0.5 mm.

produced, not reaching midlength of fourth segment, terminating in small spine; dorsomesial distal angle with small spine. First segment sometimes with spine on dorsolateral distal margin, ventromesial margin with 1 small spine lateral to rounded protrusion bordering anterior margin of antennal gland opening. Antennal aci-

cle slightly overreaching distal margin of cornea, terminating in small spine; mesial margin smooth or with few short setae. Antennal flagellum long, far overreaching extended right cheliped; articles each with few short to moderately short setae (1 to 2 articles length) on distal margin.

Mandible (left) (Fig. 3A, B) with mesial in-

cisor edge sharp, with 2 distal and 1 proximal calcareous teeth; space between incisor and molar processes deeply grooved; palp composed apparently of 2 articles, distal article broad, with short stiff setae marginally. Maxillule (Fig. 3C) with coxal endite tapering distally and with stiff setae and bristles; basal endite moderately broad, truncate mesial margin with double row of small spines; endopod with slightly produced inner lobe bearing 1 apical bristle, outer lobe somewhat produced, not recurved. Maxilla (Fig. 3D) without distinctive features. First maxilliped (Fig. 3E) with setae on entire lateral margin of exopod. Second maxilliped (Fig. 3F) with long exopod. Third maxilliped (Fig. 3G, H) with basis and ischium incompletely fused; basis with 2 or 3 denticles on mesial margin; ischium with well developed crista dentata composed of row of small corneous teeth and with 1 accessory tooth; merus unarmed on dorsodistal margin, but with small spine ventromesially; carpus unarmed; exopod overreaching distal margin of merus.

Right cheliped sexually dimorphic. Male right cheliped (Fig. 4A–E) markedly elongate. Chela subovate in general outline, 1.7–1.8 times longer than wide. Dactylus shorter than palm; surface unarmed; dorsomesial margin not delimited; cutting edge with few low, rounded calcareous teeth in proximal half, nearly smooth or with rudimentary corneous teeth in distal half, terminating in small calcareous claw. Palm shorter than carpus; dorsolateral margin faintly delimited; ventromesial margin forming distinct but blunt ridge proximally; dorsal surface convex, nearly smooth or with few low, obsolete tubercles in proximal half; lateral, mesial and ventral surfaces smooth, with few short setae; ventral surface gently convex. Cutting edge of fixed finger with low calcareous tooth in proximal half, and row of minute calcareous teeth in distal half, terminating in calcareous claw. Carpus rather narrow, about 2.0 times longer than distal width; dorsomesial and dorsolateral margins not delimited; dorsal surface with several small spines or spinulose tubercles mesially and short setae laterally; lateral surface nearly smooth, with few short setae; mesial sur-

face notably concave, with few short to long setae; ventral surface convex. Merus with smooth dorsal surface, dorsodistal margin unarmed; lateral face nearly smooth, with few short setae, ventrolateral margin with row of small spines or tubercles in distal half; mesial face subdistally with short transverse rows of setae adjacent to dorsal margin and tufts or short oblique rows of long setae adjacent to ventral margin, ventromesial margin unarmed; ventral surface with numerous long setae. Ischium unarmed on ventromesial margin; surfaces also unarmed. Coxa unarmed.

Female right cheliped (Fig. 5A–C) less elongate than male right cheliped, but still longer than left cheliped. Chela subovate or subtriangular in general outline, 1.9–2.0 times longer than wide. Dactylus distinctly longer than palm; dorsal surface unarmed; dorsomesial margin not delimited; mesial face with some low tubercles proximally; cutting edge faintly denticulate in proximal half, and with row of partially fused small corneous teeth in distal half, terminating in small corneous claw. Palm about half of carpus length; dorsolateral margin with faintly tuberculate or crenulate ridge over entire length, slightly upturned; dorsomesial margin also with faintly tuberculate or granular ridge; dorsal surface slightly convex, with some low tubercles in proximal half and scattered few short to moderately long setae; lateral, mesial and ventral surfaces smooth, lateral surface with scattered short setae, mesial and ventral surfaces with few long setae; ventral surface gently convex. Cutting edge of fixed finger with 1 very low calcareous tooth at midlength, and with row of very small, occasionally rudimentary, calcareous teeth in distal half, terminating in large corneous claw. Carpus rather narrow, about 2.0 times longer than distal width; dorsomesial margin weakly delimited by row of small spines or tubercles and tufts of long setae; dorsolateral margin not clearly delimited; dorsal surface with longitudinal row of small spines or tubercles laterally; mesial surface notably concave, with some long setae; lateral surface nearly smooth, with scattered short setae; ventral surface convex, with few long setae. Merus with

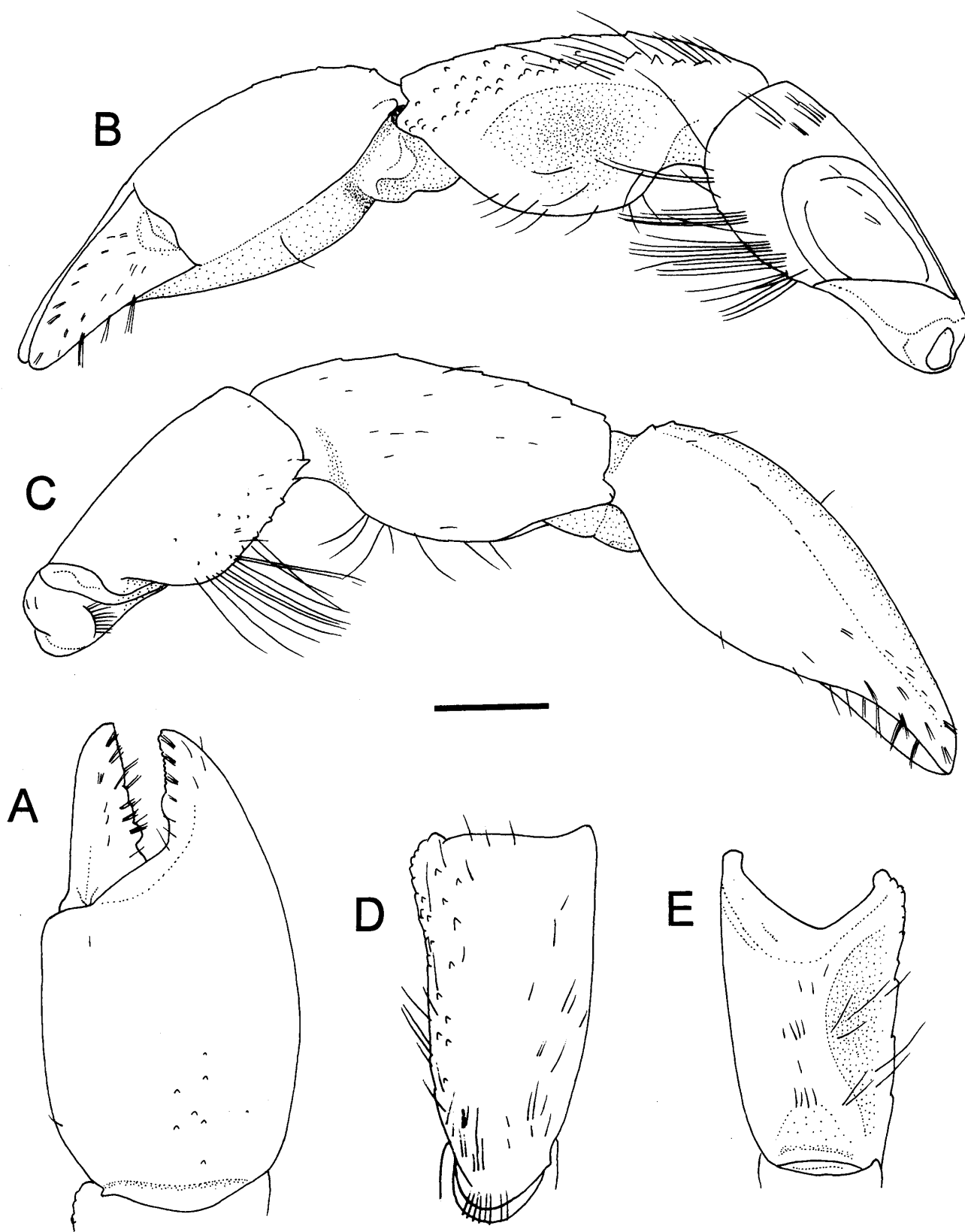


Fig. 4. *Cestopagurus puniceus* sp. nov. Holotype male (SL 2.1 mm; CBM-ZC 8356) from west of Izu-Oshima Island. Right cheliped. A, chela, dorsal view; B, entire right cheliped, mesial view; C, same, lateral view; D, carpus, dorsal view; E, same, ventral view. Scale bar: 1 mm.

dorsal surface smooth, with few tufts of short setae, dorsodistal margin unarmed; lateral face smooth, with few short setae, ventrolateral margin with row of small spines or tubercles in distal two-thirds; mesial face subdistally with 1 or 2 short transverse rows of setae adjacent to dorsal margin and few long setae adjacent to ventral margin, ventromesial margin with few low protuberances; ventral surface with some long setae. Ischium unarmed on ventromesial margin; surfaces also unarmed.

Left cheliped (Fig. 5D–F) somewhat compressed laterally. Chela 2.9–3.0 times longer than wide. Dactylus 1.2–1.4 of palm length; surfaces unarmed, but with tufts of setae (setae on ventral surface long); cutting edge with row of small corneous teeth in distal 0.6–0.7, terminating in large corneous claw. Palm about half length of carpus; dorsal midline strongly elevated and armed with row of small spines or tubercles forming crest and sometimes extending onto basal part of fixed finger; dorsomesial face unarmed but with several long setae, dorsomesial margin not delimited; dorsolateral face unarmed but with scattered very short setae, dorsolateral margin not delimited; mesial face nearly flat, with some long setae; lateral face nearly smooth, with scattered very short setae and some longer setae along dorsal margin; ventral surface gently convex, with several long setae. Merus with short individual setae on dorsal surface, dorsodistal margin unarmed; mesial face smooth, with row of long setae dorsally and short oblique rows of long setae adjacent to ventral margin, ventromesial margin unarmed; lateral face with faintly granular ventrally, otherwise nearly smooth, ventrolateral margin with row of 3 or 4 small spines followed by low protuberances and tubercles; ventral surface with several long setae. Ischium unarmed on ventromesial margin; surfaces also unarmed, but with tufts of short setae. Coxa unarmed.

Ambulatory legs (Fig. 6A, B) moderately long, right second pereopod reaching or slightly overreaching right cheliped. Dactyli (Fig. 6C, D) 1.0–1.2 of propod length, in lateral view slightly

curved ventrally, in dorsal view, nearly straight, terminating in moderately large corneous claw; dorsal surfaces each with row of tufts of short setae; lateral faces smooth; mesial faces smooth (second) or armed with row of 3–5 corneous spinules dorsally (third); ventral margins each with 8–15 (second) or 8–12 (third) moderately large corneous spines increasing in size distally. Propodi distinctly longer than carpi, 5.0–5.6 times longer than distal height, slightly curved ventrally in lateral view; dorsal surfaces each with sparse tufts of individual moderately long setae; lateral and mesial faces smooth; ventral margins each with 3 or 4 widely separated corneous spinules and few short setae and pair of slender corneous spines on ventrodistal margin. Carpi with small dorsodistal spine and sparse moderately long to long setae on dorsal surface; lateral, mesial, ventral faces smooth. Meri with row of tufts of short setae on dorsal surfaces; lateral and mesial faces nearly smooth; ventral margins each with moderately short to long setae (setae fewer in third than second), ventrolateral distal margin weakly concave, unarmed. Ischia unarmed, with setae on dorsal margin.

Fourth pereopods (Fig. 2E) semichelate, similar and subequal. Dactyli straight, each terminating in small corneous claw, without preungual process. Propodi moderately broad, with tuft of setae on dorsal surfaces; propodal rasps each consisting of single row of ovate scales. Carpi each with tuft of long setae on dorsodistal margin, Meri moderately broad, with tuft of long setae on each dorsodistal margin.

Fifth pereopods (Fig. 2F) chelate. Propodi each with rasp in distal half. Males with right coxa usually slightly larger than left, and with short to medium length of sexual tube (1.5–4.0 of coxal length) directed anteromesially, sometimes extending to left coxa (Figs. 2H, 6E, F); right sexual tube moderately slender, tapering distally, nearly straight or distally curved or twisted; transverse row of setae present at base of sexual tube posteriorly; left coxa with gonopore and tuft of short setae bordering posterior margin of gonopore, occasionally with very short sexual

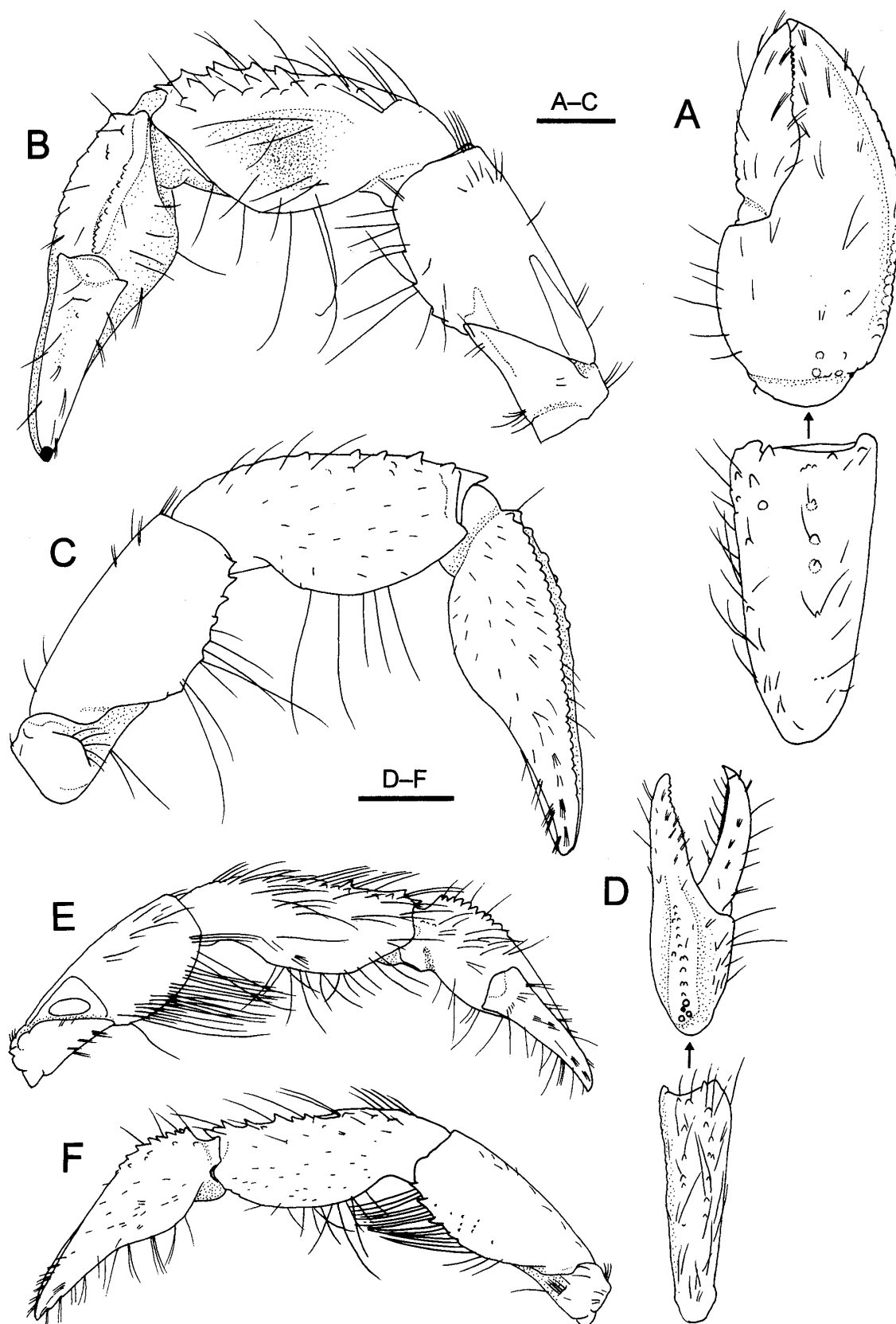


Fig. 5. *Cestopagurus puniceus* sp. nov. A–C, paratype female (SL 2.0 mm; CBM-ZC 8358) from southwest of Izu-Oshima Island; D–F, holotype male (SL 2.1 mm; CBM-ZC 8356) from west of Izu-Oshima Island. A, chela and carpus of right cheliped, dorsal view; B, entire right cheliped, mesial view; C, same, lateral view; D, chela and carpus of left cheliped; E, entire left cheliped, mesial view; F, same, lateral view. Scale bars: 0.5 mm for A–C, 1 mm for D–F.

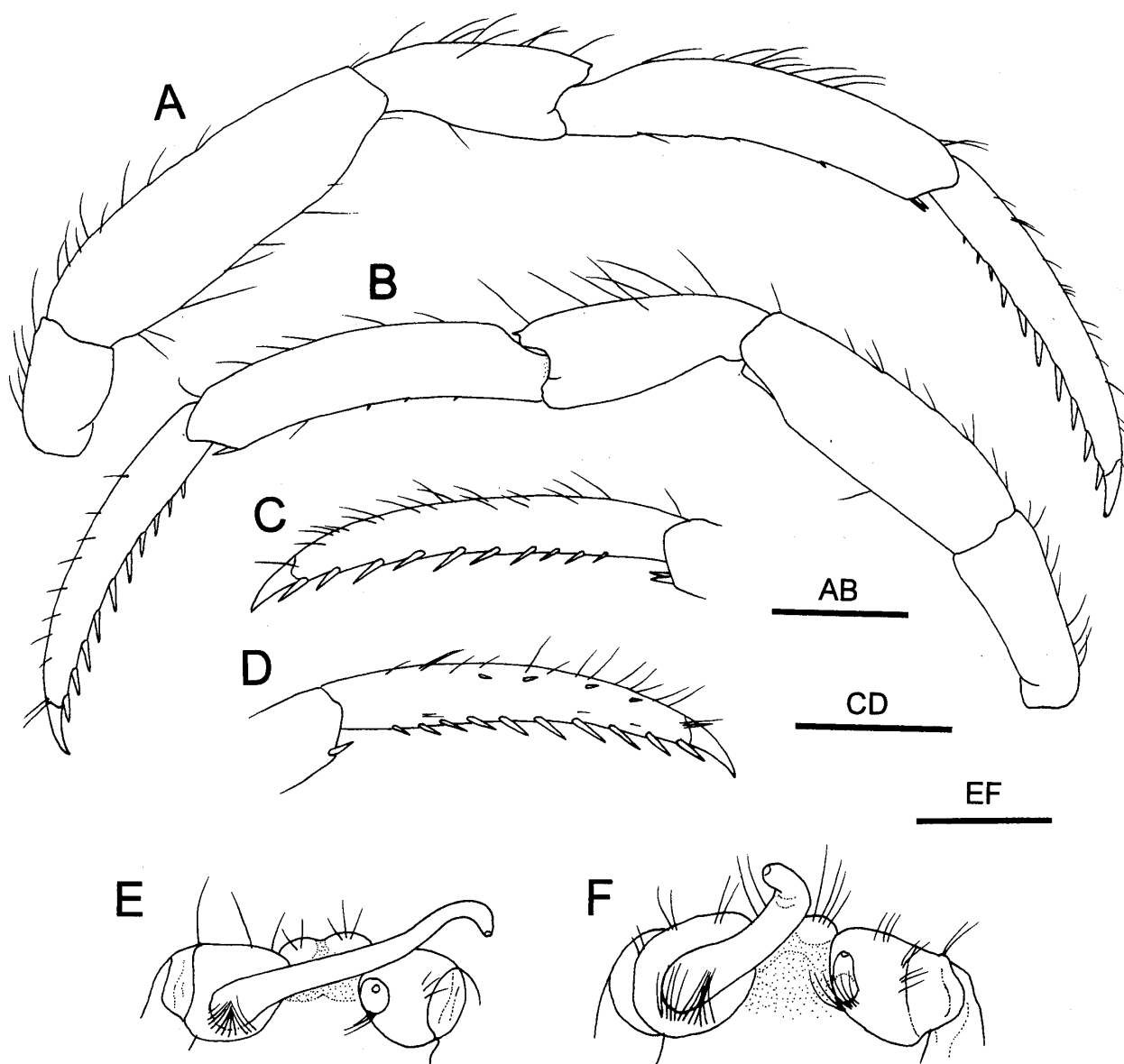


Fig. 6. *Cestopagurus puniceus* sp. nov. A–D, holotype male (SL 2.1 mm; CBM-ZC 8356) from west of Izu-Oshima Island. Ambulatory legs; E, paratype male (SL 1.8 mm; CBM0ZC 8357) from same locality; F, paratype male (SL 2.0 mm; same lot). A, right second pereopod, lateral view; B, left third pereopod, lateral view; C, dactylus of right second pereopod, mesial view; D, dactylus of left third pereopod, mesial view; E, F, coxae of fifth pereopods. Scale bars: 1 mm for A–D; 0.5 mm for E, F.

tube (Figs. 2H, I, 6F).

Third thoracic sternite with 1 small denticles on either side of shallow median notch on anterior margin, partially obscured by tuft of stiff setae. Thoracic sternum moderately narrow; anterior lobe of sixth thoracic sternite (Fig. 2G) subsemi-circular or subrectangular, with numerous setae on anterior margin. Eighth thoracic sternite (Fig. 2H) with 2 rounded, moderately separated lobes, each with tuft of setae on anterior margin.

Pleon (Fig. 1) dextrally twisted, typical of pagurids. Males with 3 unpaired, markedly unequally biramous left pleopods (third to fifth pleopods). Females with paired gonopores on coxae of third pereopods and with 4 unpaired pleopods, second to fourth pleopods subequally biramous, fifth as in males. Uropods (Fig. 3I, J) markedly asymmetrical, right larger than left; protopods occasionally with few small tubercles on ventrodistal angles.

Telson (Fig. 2J) with posterior lobes nearly symmetrical or only weakly asymmetrical; terminal margins somewhat oblique, each armed with 1 or 2 larger spines at lateral angle and row of 5–7 closely set spinules; lateral margins unarmed, each edged by thin corneal ridge.

Variations. As illustrated (Figs. 2H, 6E, F), the length of the right sexual tube varies substantially, about 1.5–4.0 of the coxal length. There is no apparent correlation between the length of the tube and the size of the animal. The degree of the curvature of the distal part of the tube is also variable as illustrated, but this variation may be an artifact.

Coloration. In life (Fig. 1). Entirely pink, without conspicuous markings on appendages.

Distribution and habitat. So far known only from off Izu-Oshima Island, Izu Islands, central Japan, at depths of 171–300 m; exclusively occupying gastropod shells.

Etymology. From the Latin *puniceus*, meaning pink, in reference to the coloration in life.

Comparison. The markedly elongate antennular peduncles, which distinctly overreach the distal margins of the corneas, and the right chela lacking conspicuous rows of spines on its dorsal surface immediately distinguish the new species from *C. coutieri* and *C. timidus*. In the latter two species, the antennular peduncles just reach the distal margin of the corneas; the dactylus of the right cheliped is provided with two or three rows of small spines on the dorsal surface in addition to the distinct row of spines on the dorsomesial margin; and the right palm is also provided with several row of small spines on the dorsal surface. The concave mesial face of the carpus of the right cheliped is also characteristic to *C. puniceus*. The rostrum of *C. puniceus* is broadly triangular and only slightly overreaches the lateral projections, rather than triangular and distinctly overreaching the lateral projections in *C. coutieri* and *C. timidus*. The ambulatory legs are less stout and less setose in the new species than in the latter two species. The right sexual tube in males seems to be shorter in *C. puniceus* than in *C. coutieri* and *C. timidus* (1.5–4.0 of the coxal

length in *C. puniceus* versus 4.0–5.5 in *C. coutieri* and *C. timidus*). Furthermore, the new species occurs at upper bathyal zone, whereas *C. coutieri* and *C. timidus* have been reported at sublittoral depths to 80 m (de Saint Laurent, 1968b; Ingle, 1993).

Remarks. As mentioned before, this new species represents the first of *Cestopagurus* known from the Pacific Ocean. Miyake (1978) referred *Catapagurus misakiensis* to *Cestopagurus*, but he did not comment in detail. Terao (1914) mentioned that the holotype of *C. misakiensis* possessed a right sexual tube being oriented to the left and across the ventral surface of the body. In this respect, *Catapagurus misakiensis* is unusual for *Catapagurus*, because species of *Catapagurus* are all characterized by the right sexual tube being oriented toward exterior then recurved over the anterior part of the abdomen (McLaughlin, 2003a; personal observation). Perhaps Miyake's (1978) assignment was based on the structure of the right sexual tube described by Terao (1914). Nevertheless, except for the structure of the right sexual tube, *Catapagurus misakiensis* is similar to some species of *Catapagurus*, particularly in the broadly rounded rostrum, the short, stout ocular peduncles with dilated corneas, and the elongate triangular ocular acicles. Unfortunately, the holotype of *Catapagurus misakiensis* is presumably no longer extant (Asakura, 2001; unpublished data), although the description of Terao (1914) needs to be verified. Considering the general similarities and the proximity of the known localities, it is highly probable that *Catapagurus misakiensis* is conspecific with *C. japonicus* or *C. imperialis* Asakura, 2001. Asakura (2001) referred six female specimens identified with *Cestopagurus misakiensis* by Miyake (1978) to *Catapagurus japonicus*.

Acknowledgments

We thank the late E. Tsuchida (Ocean Research Institute, University of Tokyo) for providing us with the specimens used in this study. Thanks are also extended to Dr. P. A. McLaugh-

lin for reviewing the manuscript. The first author is grateful to E. Tsuchida, K. Tsuchiya, H. Namikawa, T. Kurozumi and H. Komatsu for field assistance. This study was conducted under the special project supported by the National Science Museum, Tokyo.

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